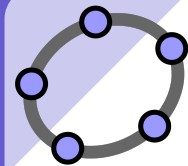


Transforming HS Geometry with GeoGebra

With Activities from Illustrative Mathematics Geometry

Jen Silverman
Mathematics Curriculum
Technology Specialist
@jensilvermath

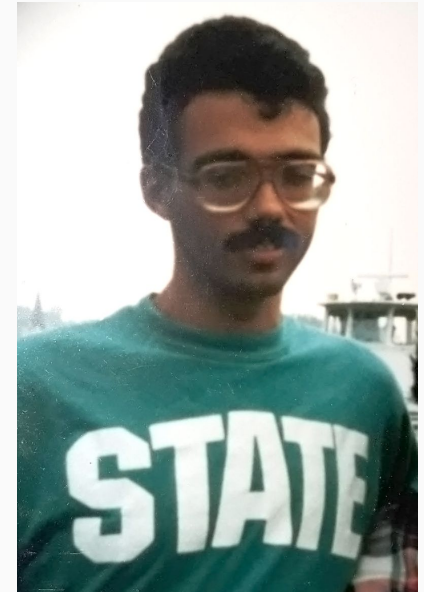
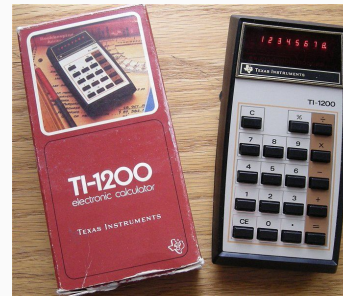
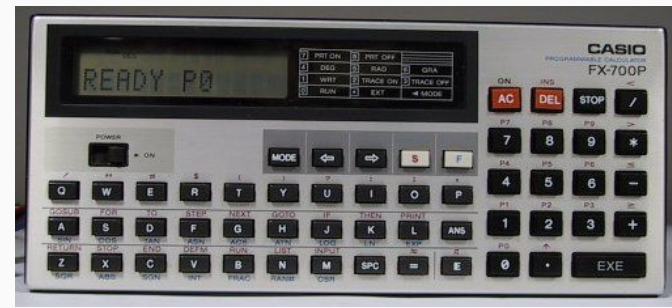
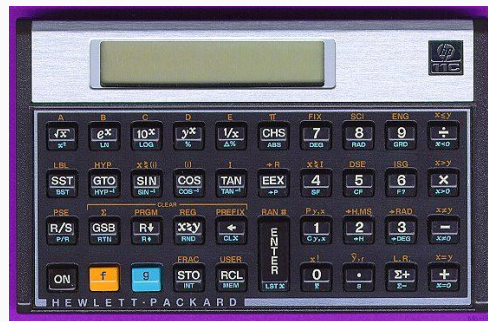
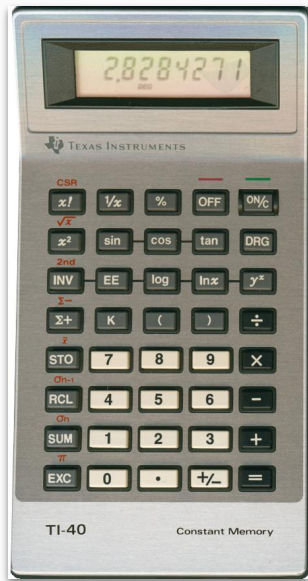
John Golden
Grand Valley State University
@mathhombre



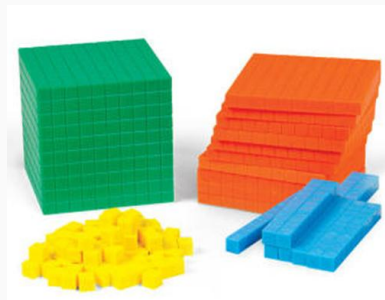
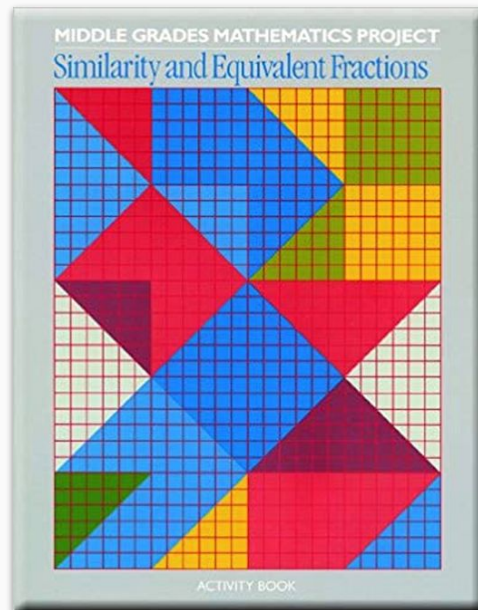
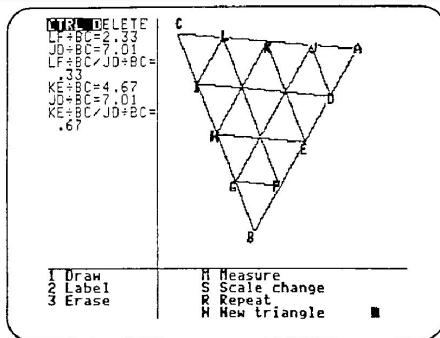
Past

WELCOME TO OUR NCTM GEOGEBRA SESSION! JEN SILVERMAN & JOHN GOLDEN APRIL 4, 2019

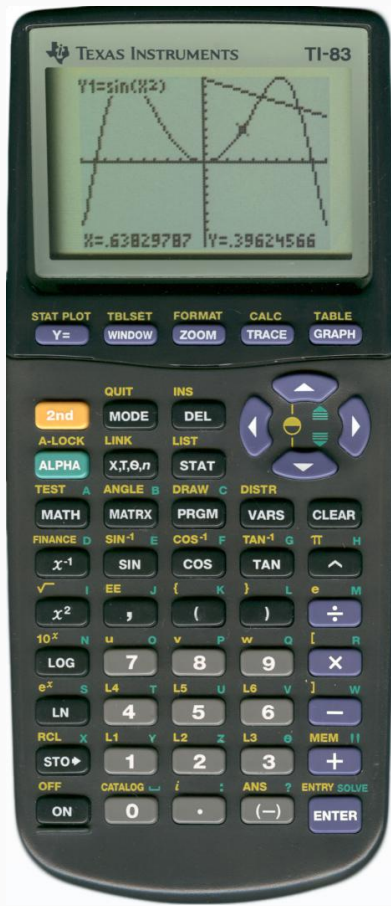
Back in the day...



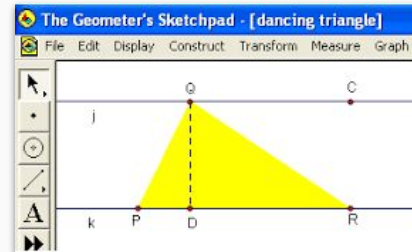
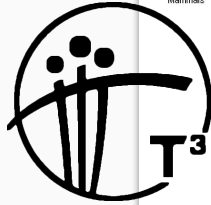
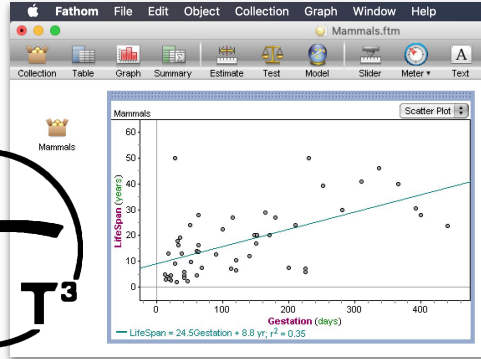
Student Days - 1980's



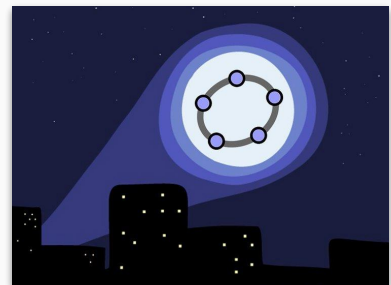
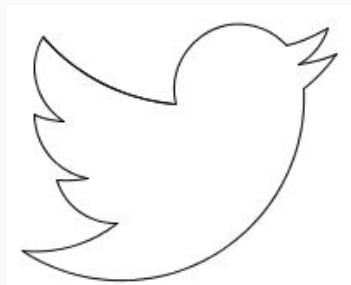
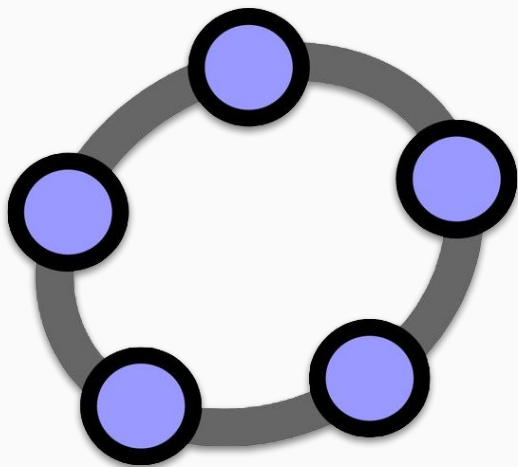
Teaching Public HS & MS in the Early 1990's



Fathom
Dynamic Data Software



Teaching in the 2000's



Our Math Ed World in the 2010's

Present



Organizing Principles for Digital Components:

A digital activity should...

- deepen understanding or replace physical manipulatives.
- cover the same math, so teachers can be flexible.
- be easy for students and teachers to access.
- not do the thinking for the student.
- not be tech for the sake of tech.

"I don't use every applet provided, but I do use them quite often. With our new state testing in Iowa, I appreciate my students being given the opportunity to manipulate the applets to enhance their learning before being given a computerized assessment." Melynee Naegele @MNMMath

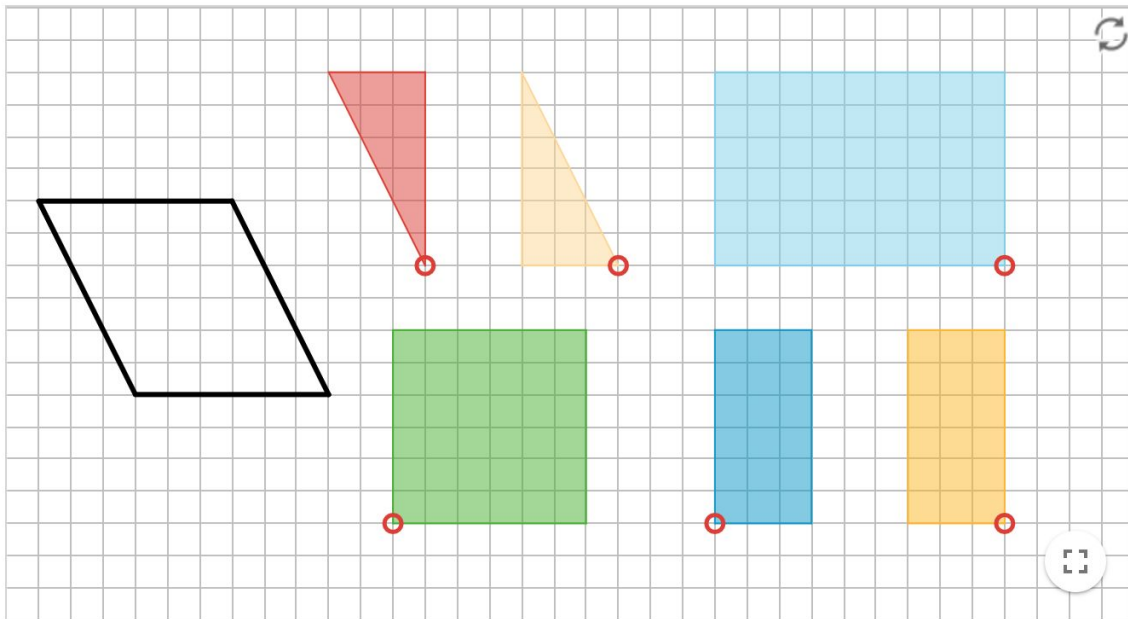
Teacher's Choice 1

Area of a Parallelogram

I LOVE the one in 6th grade unit 1 lesson 4. It's the one I have used to show parents why this curriculum is far superior to any other I have seen. Students get to experience decomposing a parallelogram and they get encouraged to use an efficient method, instead of just counting individual squares to find the area.

Alex Otto, Alaska

1. Find the area of the parallelogram and explain your reasoning.



6.1.4.2

Organizing Principles for Digital Components:

- Students have access to a suite of linked applications, including graphing tools, synthetic and analytic geometry tools, and spreadsheets. Students (and teachers) are taught how to use the tools, but not told when to use them, and student choice in problem-solving approaches is valued.
- Digital versions are developed when they are required by the Standard being addressed, or when they offer a meaningful alternative to the paper and pencil version to achieve the learning goals of the lesson.
- The technology fits the curriculum, not the other way around.

On Demand Math Tools - MP5 Envisioned

The screenshot shows the website interface for Illustrative Mathematics by Kendall Hunt. The top navigation bar includes links for IM Curriculum, Professional Learning, About Us, Contact Us, and Register/Log In. The main header features the Illustrative Mathematics logo, a 'Geometry' dropdown menu, the Kendall Hunt logo, and a 'Math Tools' dropdown menu. The 'Units' section is highlighted, showing 'UNIT 1: Constructions and Rigid Transformations' with a list of topics: Constructions, Rigid Transformations, Evidence and Proof, and Designs. The 'Math Tools' dropdown menu is open, displaying a list of tools: Four-Function Calculator, Scientific Calculator, Graphing Calculator, Geometry, Spreadsheet, Probability Calculator, and Constructions.

IM Curriculum Professional Learning About Us Contact Us Register/Log In

iM Illustrative Mathematics

Geometry ▾

Kendall Hunt Math Tools ▾

Units

UNIT 1
Constructions and Rigid Transformations

- Constructions
- Rigid Transformations
- Evidence and Proof
- Designs

Four-Function Calculator

Scientific Calculator

Graphing Calculator

Geometry

Spreadsheet

Probability Calculator

Constructions

im.kendallhunt.com/HS/index.html

Constructions

Students have worked so much with numbers, equations, variables, coordinate grids, and other quantifiable structures, that it may come as a surprise just how far they can push concepts in geometry without them. Constructions with straightedge and compass introduce students to reasoning about distances, generating conjectures, and attending to the level of precision required to define rigid motions.

The screenshot shows the top navigation bar of the Illustrative Mathematics website. On the left is the logo with a stylized 'iM' and the text 'Illustrative Mathematics'. To the right are two dropdown menus: 'Geometry' and 'Unit 1'. Below these is a 'Lesson' section with a horizontal list of numbers from 1 to 16. The number 8 is highlighted in purple. Below the lesson list, the text 'LESSON 8' is displayed in a light gray font, followed by the title 'Using Technology for Constructions' in a large, bold black font. At the bottom of this section are two tabs: 'Lesson' and 'Practice', with 'Lesson' being the active tab. Below the tabs is a purple rectangular box containing the text '8.1: How Do Digital Construction Tools Work?' in white.

Geometry ▼ Unit 1 ▼

Lesson

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

LESSON 8

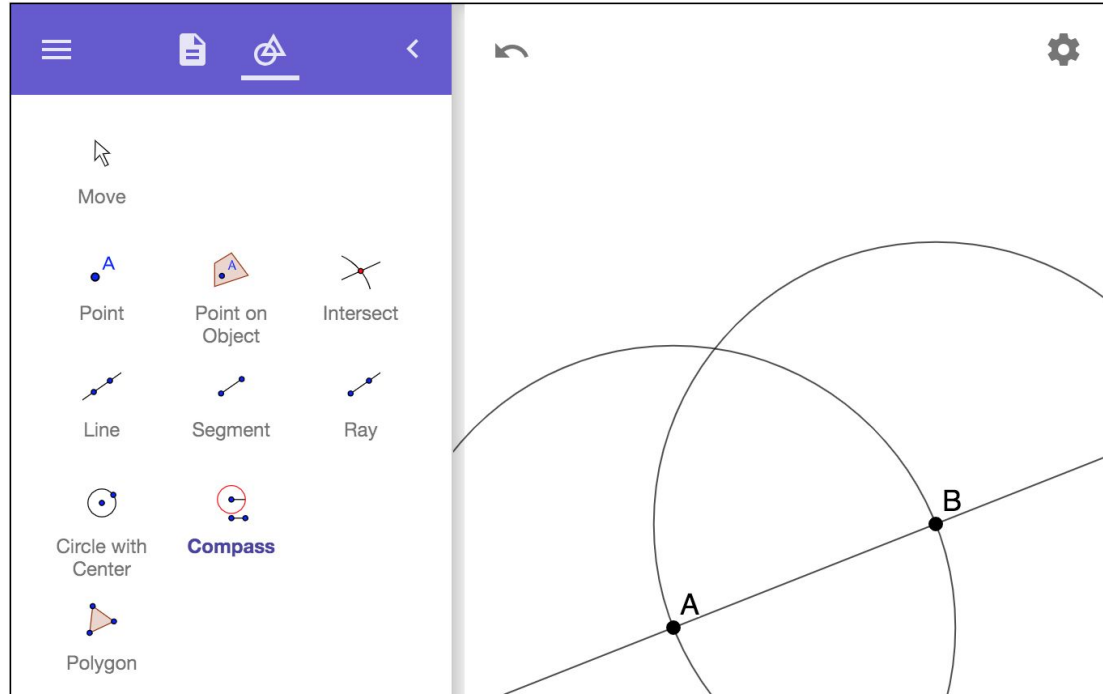
Using Technology for Constructions

Lesson Practice

8.1: How Do Digital Construction Tools Work?

bit.ly/IM-G1-8

Constructions



8.2 Additional Challenges

- Parallel to a line through a point not on the line
- Same with no perpendiculars

Transformations

The focus on transformations in IM Geometry shifts from transforming whole figures, as they did in MS, toward a more point-by-point analysis. The rigorous definitions students develop are used to prove statements involving angles, distances, and congruence. This perspective marks a transition to thinking about transformations as functions that take points as inputs and produce points as outputs.



Illustrative
Mathematics

Geometry ▾

Unit 1 ▾

Lesson

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

LESSON 20

Transformations, Transversals, and Proof

Lesson

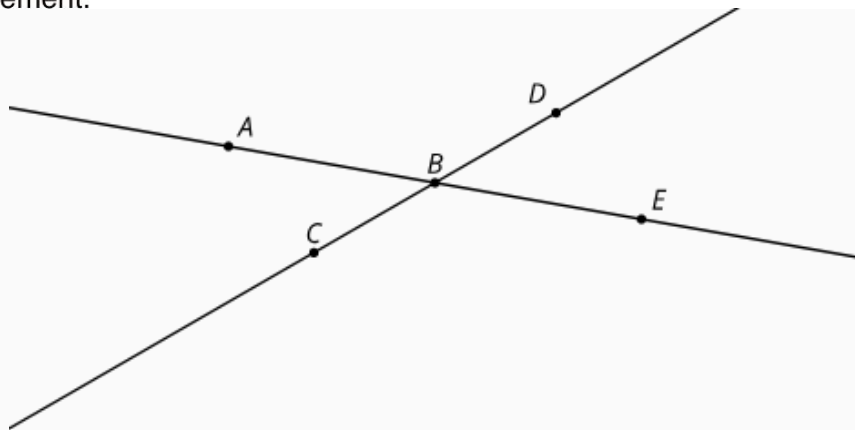
Practice

20.1: Math Talk: Angle Relationships

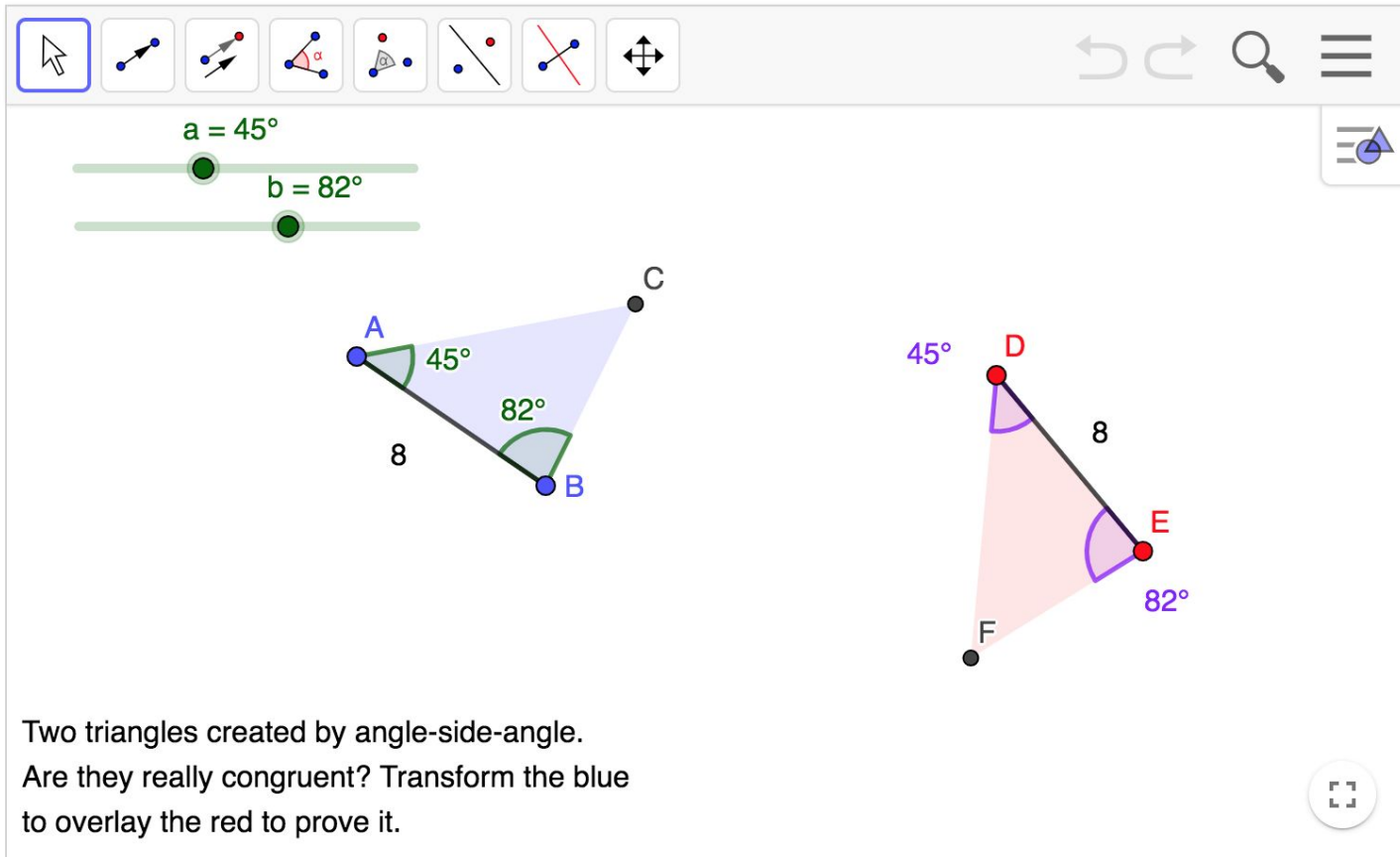
bit.ly/IM-G1-20

20.2: Make a Mark? Give a Reason.

1. Translate lines AE and CD by the directed line segment from B to C . Label the images of A, B, C, D, E as A', B', C', D', E' .
2. What is true about lines AE and $A'E'$? Explain your reasoning.
3. Take turns with your partner to identify congruent angles.
 - a. For each pair of congruent angles that you find, explain to your partner how you know the angles are congruent.
 - b. For each match that your partner finds, listen carefully to their explanation. If you disagree, discuss your thinking and work to reach an agreement.



Transformations



Two triangles created by angle-side-angle.

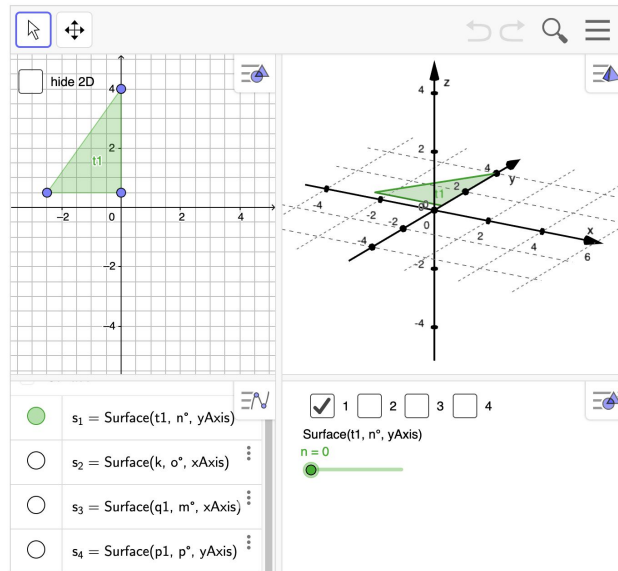
Are they really congruent? Transform the blue to overlay the red to prove it.

Solid Geometry

In this IM unit, students practice spatial visualization in three dimensions, study the effect of dilation on area and volume, derive volume formulas using dissection arguments and Cavalieri's Principle, and apply volume formulas to solve problems involving surface area to volume ratios, density, cube roots, and square roots.

Axis of Rotation

Author: IM HS Curriculum Pilot

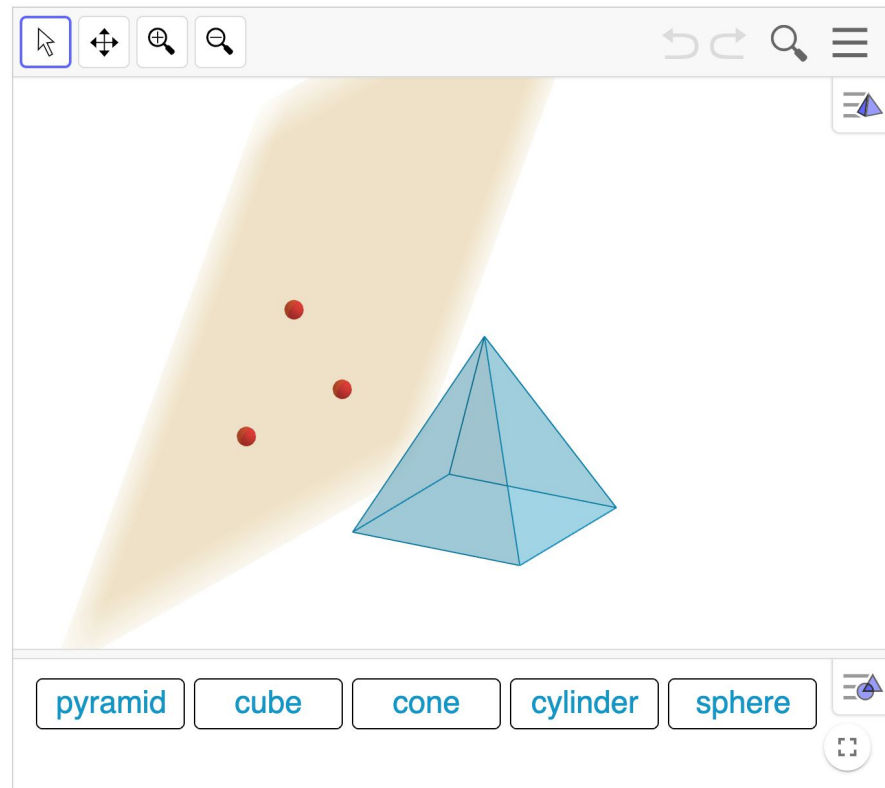


ggbm.at/e4jhspvn

1. Explore the applet. How does the Surface command work?
2. Partner A:
Choose a 2D shape. Change it. Rotate it. Hide the 2D parts.
3. Partner B:
Rotate the 3D view. Sketch your partner's 2D shape. Did you match it?

Slice That 5 Ways

Author: IM HS Curriculum Pilot



Explore the applet.

Which solids could have cross-sections shaped like...

- any quadrilateral?
- a square?
- any triangle?
- a circle?
- both a circle and a square?
- a regular hexagon?

What other questions would you ask?

GeoGebra Math Apps

Get our free online math tools for graphing, geometry, 3D, and more!

START GRAPHING

CLASSROOM RESOURCES



New Math Apps

Graphing Calculator
Geometry
3D Graphing
Scientific Calculator

Classic Apps

GeoGebra Classic
Spreadsheet
Probability
CAS

Offline Apps

Augmented Reality
App Store
Google Play
Microsoft Store

Make a cube and its net in under a minute.

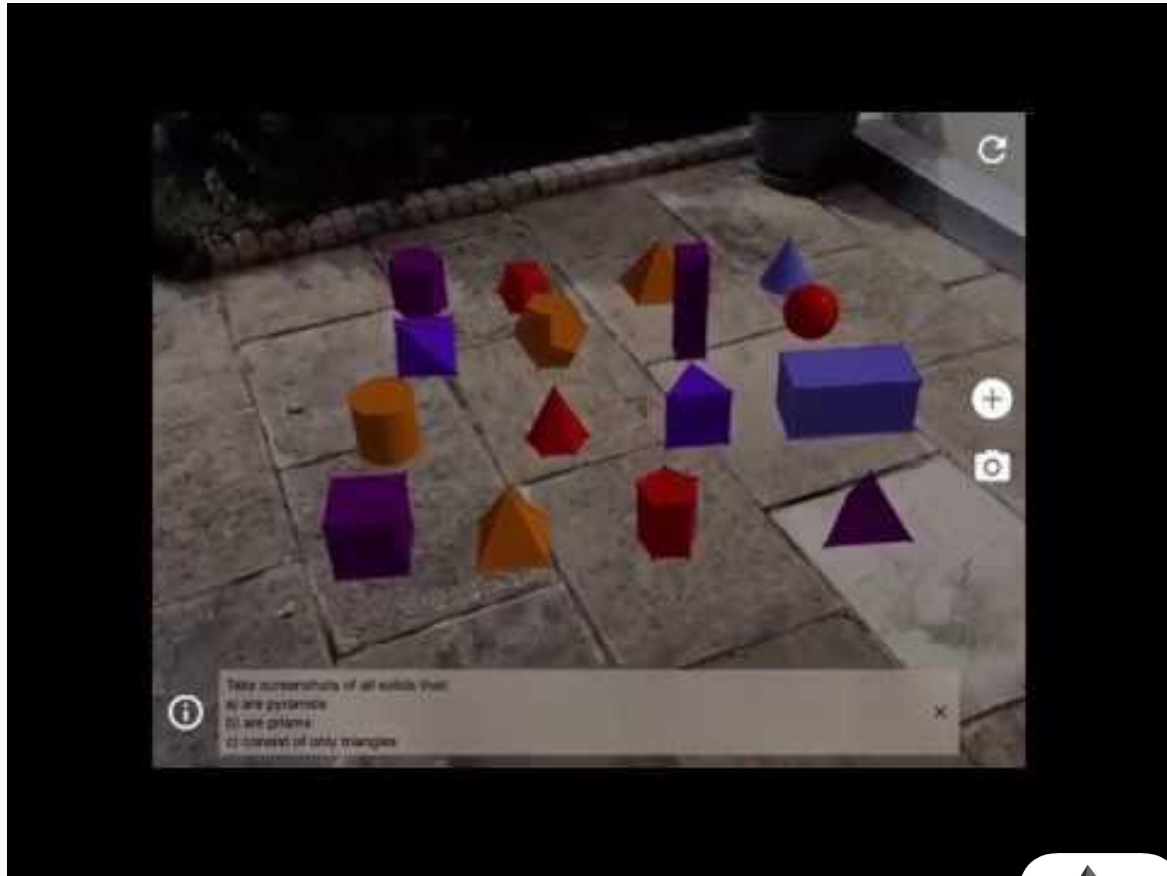
1. Open [geogebra.org](https://www.geogebra.org)
2. Select 3D Graphing
3. Select Cube
4. Click 2 points in the graph
5. Select Nets
6. Click on the cube
7. Select the Move tool
8. Grab the net & move it
9. Say woot!

Future?

Augmented Reality

Place math objects on any surface, walk around them, and take screenshots from different angles.

Millions of people around the world use GeoGebra to learn mathematics and science. Now there's GeoGebra AR to explore the potential of augmented reality. This is just the start!



ggbm.at/fmbmkpj7



Thanks!

Notices, Wonders, Questions?

bit.ly/silvergoldnctm

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proradian.net

John Golden, @mathhombre,
goldenj@gvsu.edu,
mathhombre.blogspot.com

Selected Resources

- Cambridge Espresso: technology use in secondary math
- Illustrative Mathematics: the curriculum
- Math Curricula from Open Up Resources
- Make a Punch Card
- Freudenthal Institute Secondary Math
- Fathom dynamic statistics software
- K-12 Open Education Resources: overview blogpost